CHAPTER 7

AIR CLEANING

Section I. AVAILABLE EQUIPMENT

7-1. Air Filters

Means for air cleaning may be classified as: viscous air filters, which may be of the throwaway, washable, or automatic type; dry air filters; electrostatic precipitators; and air washers. Viscous filters clean air by trapping the impurities which are directed against surfaces coated with a viscous fluid. Most of the dust is held by sticking to the viscous surface, although as the quantity of dirt held in the filter increases, some dirt is filtered out by screening action. These filters may be made of metal screening in removable units which can be cleaned and recoated when necessary ((1) and (2), fig. 7-1). The principle of viscous entrapment is also used in many throwaway or renewable filter units which are made of an inexpensive media such as glass wool ((3), fig. 7-1). Larger types are also made for permanent installation where the cleaning and recoiling operation is carried on automatically. Most air filters in use are of the viscous type. Their efficiency is adequate for general filtration and the owning and operating cost is usually less than that of other air cleaning methods. Dry filters use a collecting surface of cloth, felted paper, or similar material which, though it may be cleaned several times, must ultimately be replaced. Though these filters require a large collection surface, their efficiency is higher than that of viscous filters and they are generally used where high efficiency is desired and the total amount of dust to be collected is small. Air is also partially cleaned when passing through air washers as used in some air conditioning systems. An air washer consists of a chamber in which air is brought in contact with water sprays, the water usually being caught in the base of the chamber and recirculated through the spray heads by a pump. Eliminator plates at the air discharge connection prevent the carryoff of liquid water in the air stream. The cleaning efficiency of these washers is poor compared to the air filtration method, particularly where carbon or greasy dust partices must be removed.

7-2. Electrostatic Precipitators

Air can also be cleaned by electrostatic precipitation (figs. 7-2 and 7-3). In this method of cleaning, the particles of foreign matter are given an electrical charge while passing through an electrostatic field and then collected on metal plates of opposite polarity. Approximately 12,000 volts (direct current) are used to create the ionizing field, and 5,000 volts (direct current) are required on the collecting plate. Although the current used is small, these voltages are capable of giving a severe shock, and safety measures should be provided to prevent injury to personnel. This usually takes the form of an automatic switch to break the precipitator circuit when the door to the unit is opened. Precipitators, although high in cost, have the advantage of relatively high cleaning efficiency, particularly for very fine dusts or smoke which are difficult or impossible to remove by any other methods of air cleaning. They also offer low resistance to air flow. Precipitators must be cleaned at regular intervals by rapping or washing the accumulator plates to remove the dust collected.

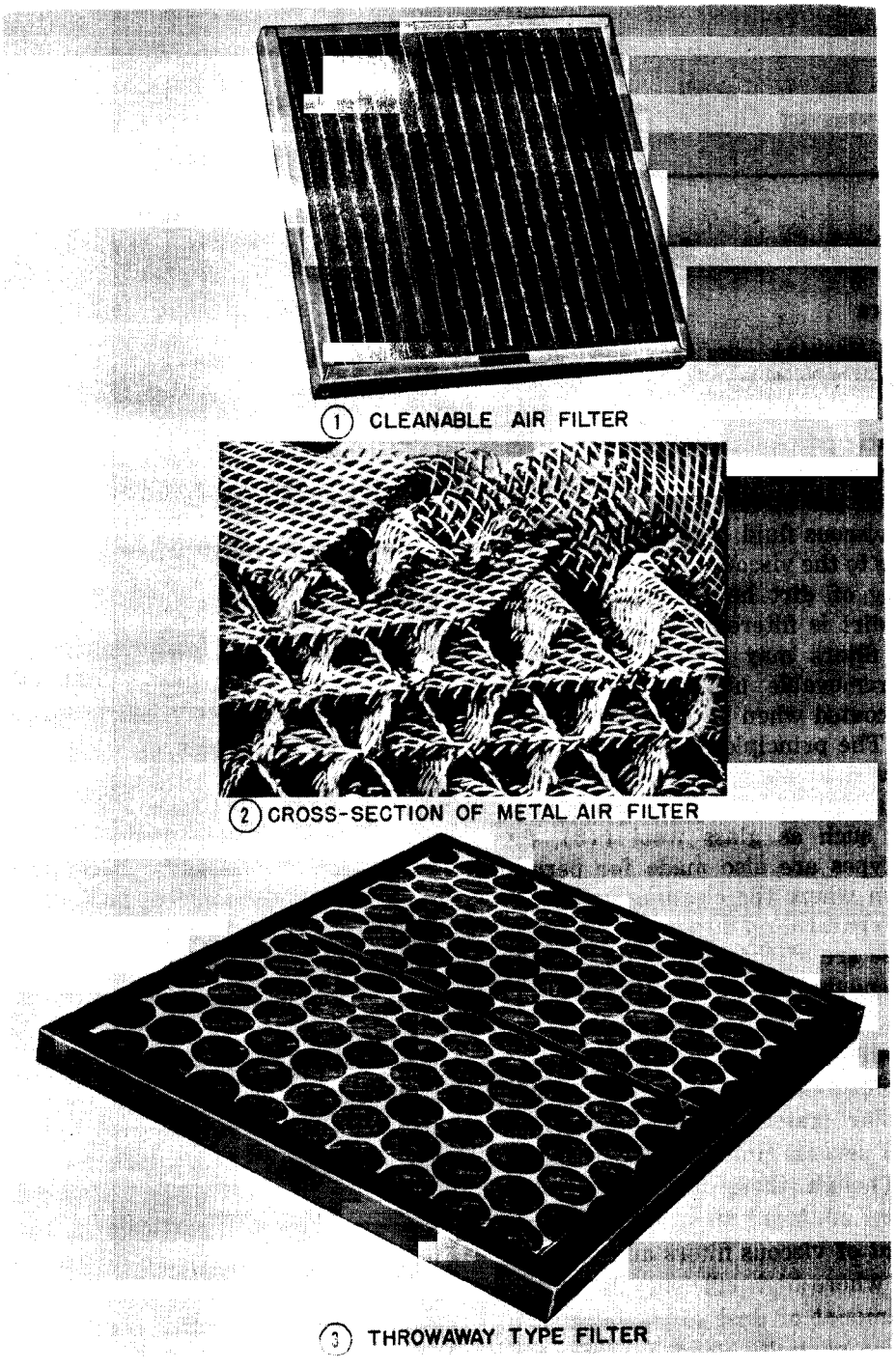

Figure 7–1. Air filters.

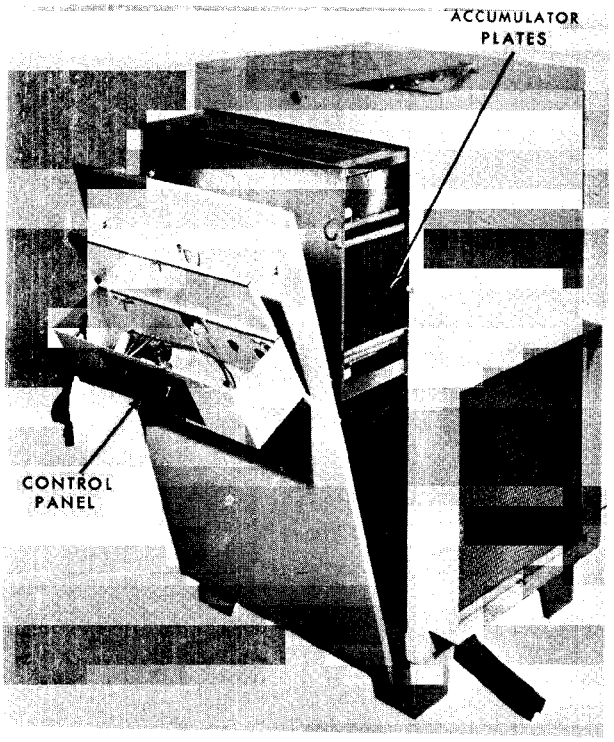

Figure 7–2. Electrostatic precipitator.

7–3. Grease Filters

The removal of grease from air exhausted from kitchens or other greasy atmospheres requires special equipment, and grease filters have been developed for this purpose. These filters are installed as near to the point of air exhaust as practicable and are frequently located in the exhaust hood itself to prevent grease from collecting within the exhaust duct system where it becomes both a health and fire hazard (fig. 7–4). Grease filters are usually of metal mesh 2 to 4 inches thick and are designed to be cleaned and reused (para 7–8). They do not have to be oiled before being placed in service.

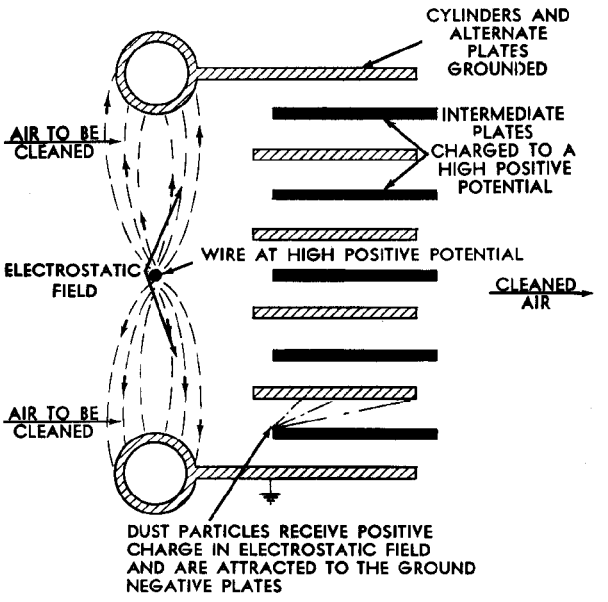

Figure 7–3. Diagrammatic cross section of precipitation.

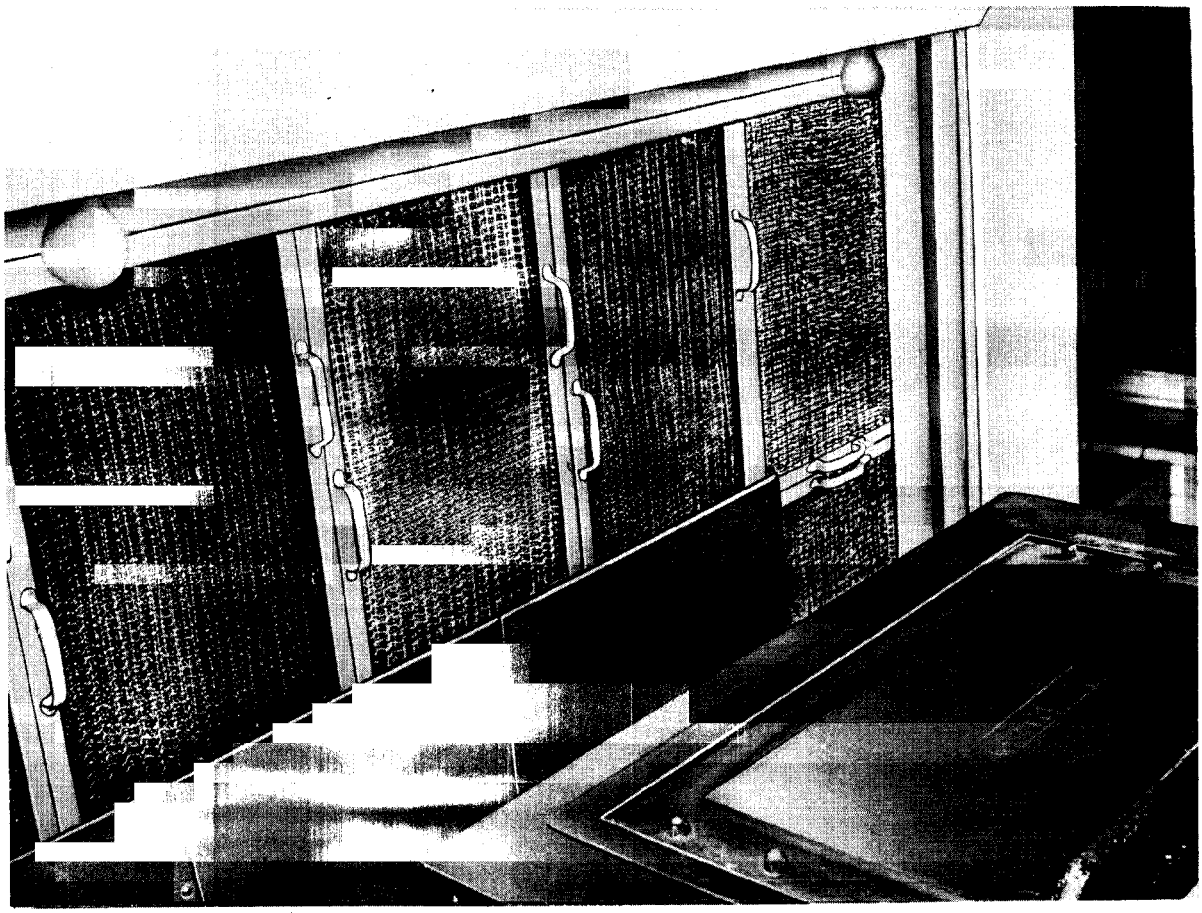

Figure 7-4. Grease filters in range hood.

Section II. INSTALLATION

7-4. Selecting Filter Size

The cleaning efficiency of the various types of filters, precipitators, and air washers varies with the air velocity through them. Optimum air velocities range from 250 f.p.m. to 700 f.p.m., depending on the filter used. Manufacturers' data should be consulted in selecting filter velocity. To determine filter area, divide the total air flow in c.f.m. by the desired filter velocity in f.p.m. Filtering efficiency, dirt-holding capacity, and the length of service all usually increase with filter area and thickness, and there is greater danger of selecting filters which are too small than filters which are too large.

7-5. Location

The filter bank is located ahead of the fan and all other elements of the heating, cooling, or ventilating system, particularly finned heating or cooling coils. In this way, filters can prevent accumulation of dirt on this equipment and, in the case of coils, prevent the reduction of air flow. Filters are so located in the system that all air circulated passes through them. If air cleaning efficiency is of particular importance, they are clamped in place or sealed at the edges with tape to prevent the leakage of air around the filter. Where the space occupied by a flat bank of filters would be excessive, units

of the filter bank may be arranged zigzag fashion to reduce space requirements. Filters must be so located that they may be removed for inspection and replaced easily.

Section III. MAINTENANCE

7-6. Inspections

As an air filter fills up with dirt, its resistance to air flow increases and the air flow through the filter decreases until it reaches a point where it is necessary to clean or replace the filter. If filters are not serviced when required, the reduced air flow will cause poor air distribution, high operating costs, inadequate ventilation, and the like. Where filters are to be used, a regular inspection schedule must be established and maintained. Experience with each installation will indicate the frequency of inspection required. Filters may be inspected visually for the degree of loading. For large installations the post engineer may establish a maximum permissible pressure drop across the filter bank, and the condition of the filter may be checked by means of a draft gage reading across the bank. The performance of large banks of unit filters can be held reasonably constant by a program of replacing or cleaning only a portion of the bank at any one time and maintaining the remaining portion in rotation on a regular schedule.

7-7. Throwaway Filters

The condition of throwaway filters usually used in warm-air heating systems can be roughly checked by holding them up to the light. When little or no light shines through the filter, replacement is required. Washing and reoiling these filters is not recommended. They are usually made with a graduated filtering medium most densely packed on the outlet side, the purpose being to increase the dirt-holding capacity of the filter. When installing

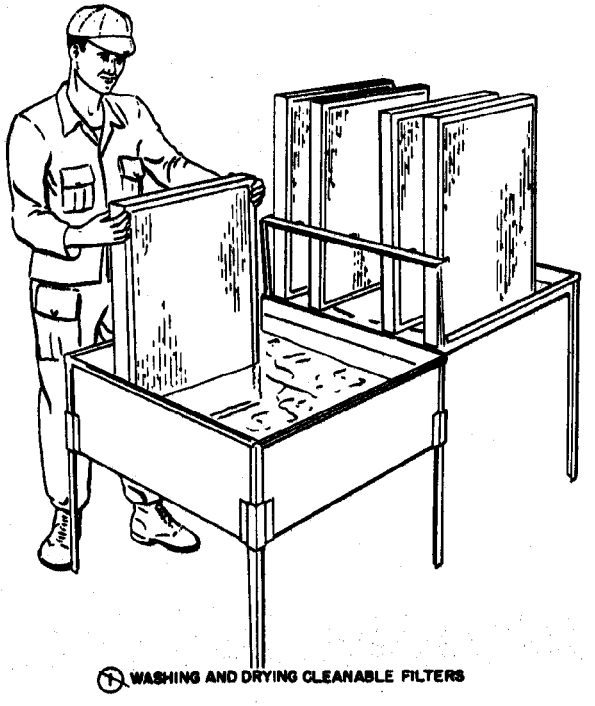

Figure 7-5. Servicing cleanable filters.

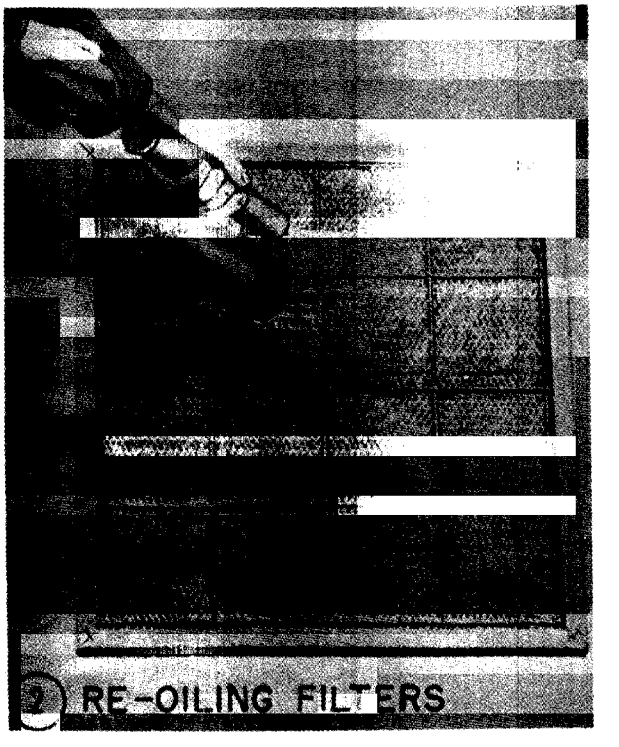

Figure 7-5—Continued.

them, make certain that the filter is placed with the denser filtering medium on the outlet side. These filters are usually marked to indicate the proper direction of air flow through them.

7–8. Cleanable Filters

Cleanable filters may be renewed by washing them in a strong solvent, allowing them to dry thoroughly, and then reoiling them by dipping or spraying with a hand sprayer (fig. 7–5). Filters are recoated only with the adhesive specified for the purpose. These adhesives, which are available through filter manufacturers, should be odorless and fire resistant. They should have a high capillarity, or ability to wet, hold dust at all operating temperatures, prevent mold formation, and evaporate slowly.